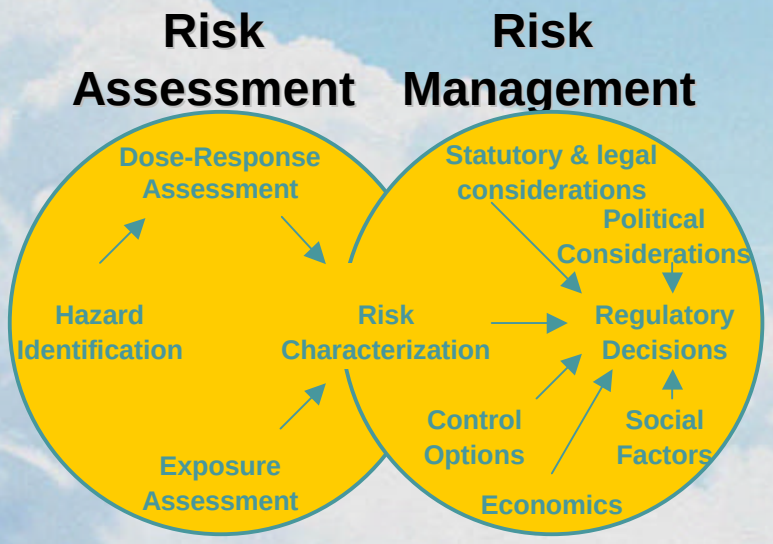
Overview of Air Toxics Exposure Assessment in ORD

Tim Watkins

National Exposure Research Laboratory (NERL)

Alignment of ORD Labs with Risk Paradigm



National Exposure Research Laboratory	National Health and Environmental Effects Research Laboratory	National Center for Environmental Assessment	National Risk Management Research Laboratory	National Center for Environmental Research
Research to measure, characterize & assess exposures and to support compliance with environmental regulations and policies	Research to identify hazards & characterize "Dose-Response"	Risk characterization & research on risk assessment methods	Research & technology transfer to prevent, mitigate & control pollution	Extramural program - grants, fellowships, & national centers of excellence - to complement ORD's intramural program

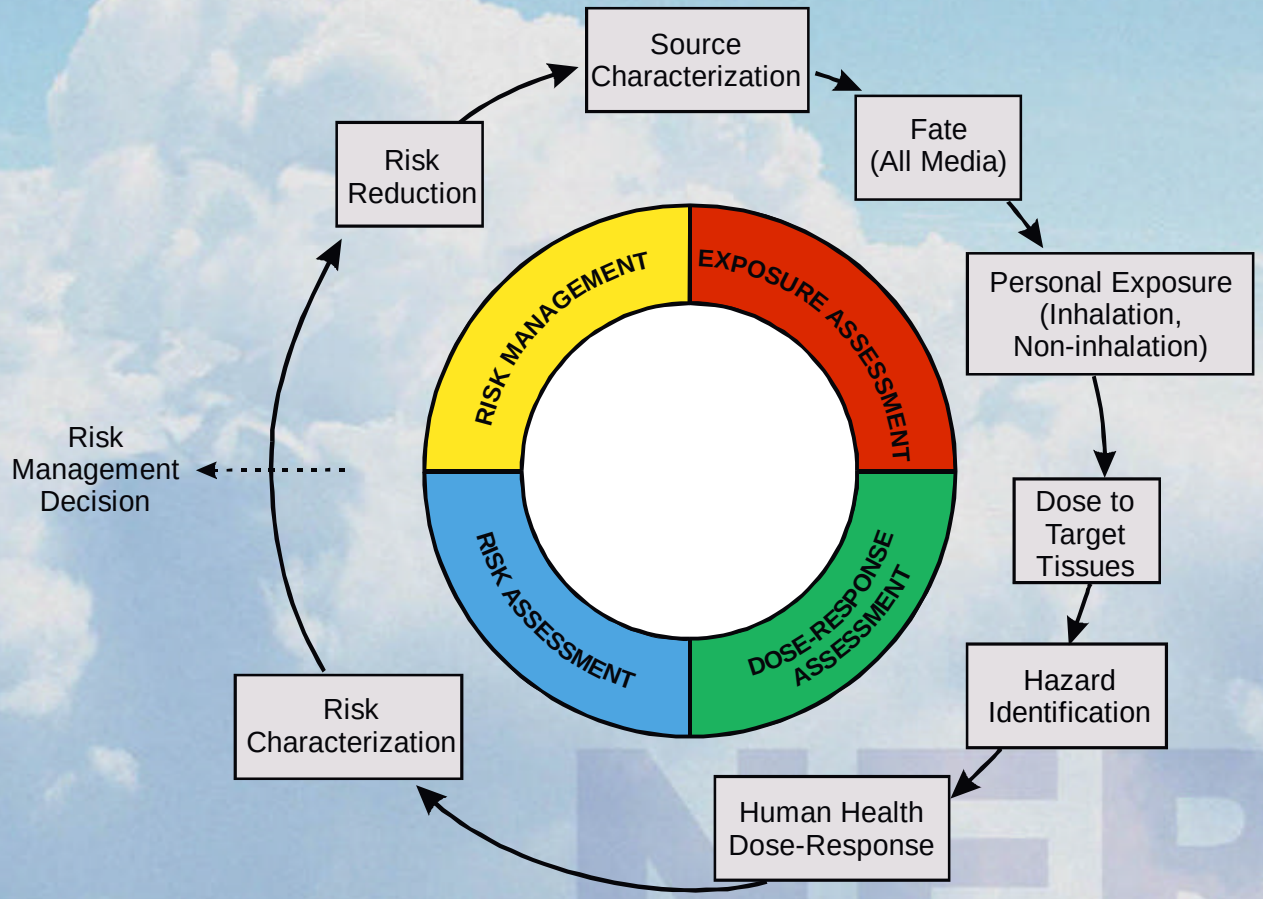
Documents that Guide ORD's Air Toxics Research Program

- Air Toxics Research Strategy (ATRS)
  - Key research questions
  - Strategic principles
  - Air Toxic groups / important chemicals within the groups
  - Long Term Goals (concepts)
- Air Toxics Multiyear Plan (MYP)
  - Long Term Goals (defined)
  - Annual Goals and Measures to meet Long Term Goals
  - Progression and inter-relationships of ORD's research
  - Implementation activities of ORD's research
- Both documents will be undergoing peer review and will be publicly available in the near future

Exposure Assessment Questions in the Air Toxics Research Strategy

- What are the sources of air toxics and what are their characteristics?
- What is the role of atmospheric transport, transformation, fate, and chemistry on air toxics concentrations, including indoor, micro-scale, urban, terrestrial, and regional concentrations?
- What is the relationship of concentrations of air toxics (from outdoor and indoor sources) to personal exposure?
- What are the health hazards and dose-response relationships associated with exposures to air toxics?

Exposure Assessment in the Risk Paradigm



ORD Air Toxics Exposure Assessment Activities

- Source Characterization / Identification
  - Emissions Measurements (NRMRL/NERL)
  - Emission Factors / Source Profiles (NRMRL)
  - Source Apportionment Modeling (NERL)
- Atmospheric Fate
  - Atmospheric Chemistry (NERL)
  - Atmospheric Dispersion Modeling (NERL)
  - Atmospheric Measurements (NERL/NCEA)
  - Measurement Methods (NERL)

ORD Air Toxics Exposure Assessment Activities

- Personal Exposure
  - Human Exposure Measurements (NERL)
  - Human Exposure Modeling (NERL)
  - Multipathway exposures (NERL/NCEA)
- Dose to Target Tissues
  - Dose modeling (NERL/NHEERL/NCEA)
  - Exposure-Dose-Response Relationships (NHEERL)

ORD's Air Toxics Exposure Assessment Research - Source Characterization

- Objective
  - Characterize emissions from sources of air toxics
  - Identify source contributions of measured concentrations
- Current Activities
  - Emissions measurements for developing emission factors and source profiles
  - Source apportionment model development and application
- Projected Outputs
  - Improved emission factors for developing emission inventories
  - Source apportionment modeling data and tools

ORD's Air Toxics Exposure Assessment Research – Fate (Atmospheric Chemistry)

- Objective
  - Characterize the atmospheric chemical and physical processes that impact the fate (including secondary formation) of air toxics
- Current Activities
  - Literature based chemical mechanisms for the 33 Urban Air Toxics
- Projected Outputs
  - Chemical algorithms for incorporation into air quality models

ORD's Air Toxics Exposure Assessment Research – Fate (Atmospheric Modeling)

- Objective
  - Develop a modeling system that estimates the dispersion and deposition of air toxics at multiple scales
- Current Activities
  - Community Multiscale Air Quality (CMAQ) Modeling System
- Projected Outputs
  - Incorporation of benzene, formaldehyde, acetaldehyde, mercury, and dioxin into the CMAQ system
  - 1 to 2 additional air toxics to be incorporated per year

ORD's Air Toxics Exposure Assessment Research – Fate (Atmospheric Measurements)

- Objective
  - Characterize atmospheric processes that affect the fate of persistent toxics
  - Measure ambient concentrations of persistent toxics
- Current Activities
  - High Altitude Mercury monitoring
  - National Dioxin Air Monitoring Network (NDAMN)
- Projected Outputs
  - Data and information to improve risk management decisions
    - understanding of the fate of persistent toxics
    - atmospheric models
    - understanding of long range transport

ORD's Air Toxics Exposure Assessment Research – Fate (Measurement Methods)

- Objective
  - Develop / refine methods for measuring air toxics in the ambient air and for human exposure studies
- Current Activities
  - Investigation of the DNSH method
- Projected Outputs
  - Field validated method for measuring acrolein and other carbonyls for use in the air toxics ambient monitoring network

ORD's Air Toxics Exposure Assessment Research – Personal (Human) Exposure

- Objective
  - Characterize the relationships between ambient, outdoor, indoor, and personal concentrations and identify the factors which influence personal exposure
  - Measure indirect exposures to persistent toxics
- Current Activities
  - Air toxics human exposure measurement study
  - Human exposure model development
  - Measurements of persistent toxics in food (e.g., breast milk)
- Projected Outputs
  - Measurement data in HEDS (NERL database) and data analyses
  - SHEDS – Air Toxics
  - Data on indirect exposure to persistent toxics

ORD's Air Toxics Exposure Assessment Research – Dose to Target Tissues

- Objective
  - Develop linkages between exposure concentrations and biological models for effects
  - Set the framework for understanding the relationship between concentrations and durations of exposure
- Current Activities
  - Development of exposure-dose-response relationships
  - Dose modeling (e.g., PBPK models)
- Projected Outputs
  - Input for dose response assessments (e.g., RfC, RfD)
  - An integrated "Source-to-Dose" human exposure model

A Message from our Health Scientists: The Importance of Matching Health and Exposure Information

Exposure Information

- TRI: mean annual averages
- NATA: mean annual averages

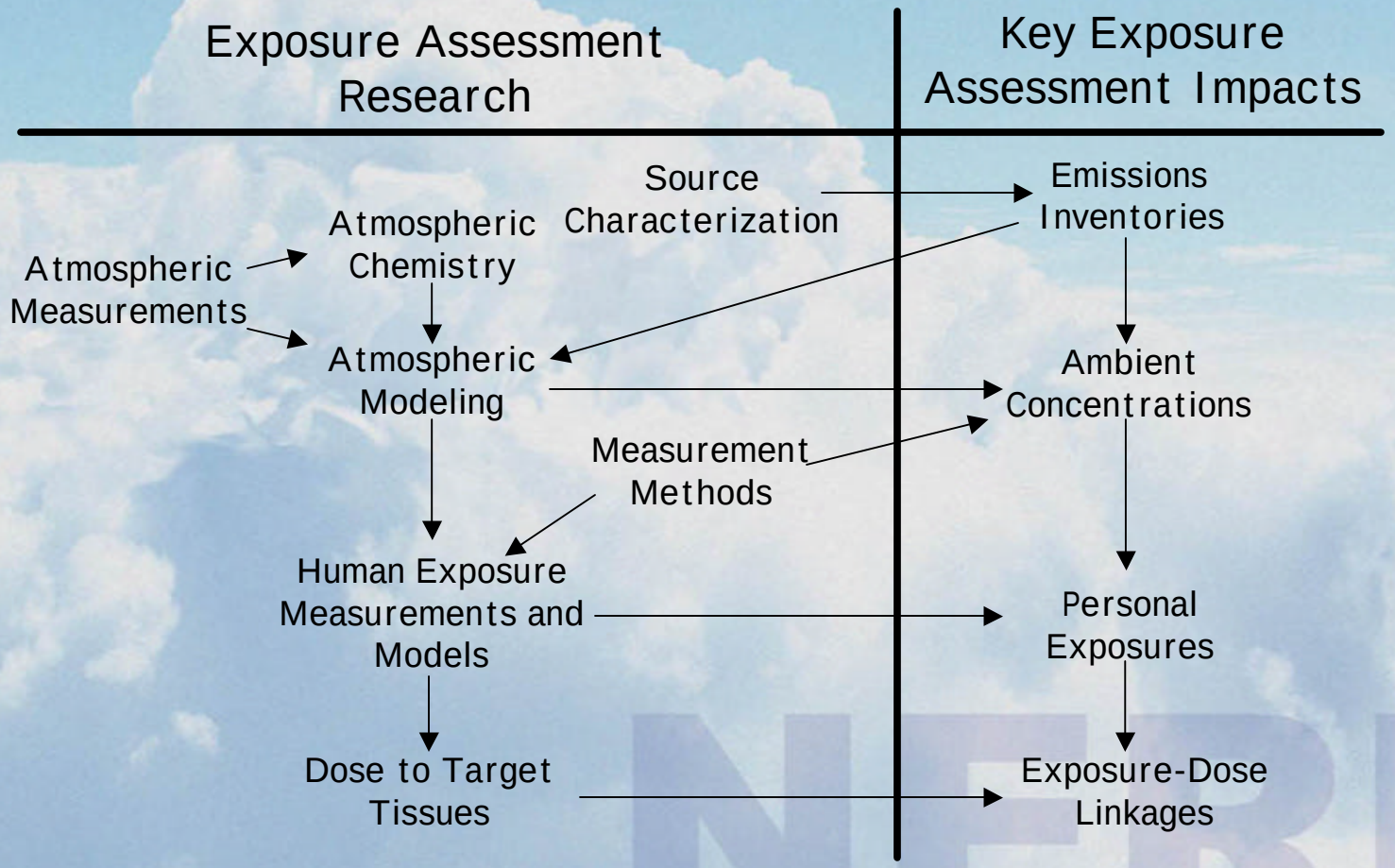
Health Effects Reported

- Acute exposures: 142
- Subchronic: 122
- Chronic: 52

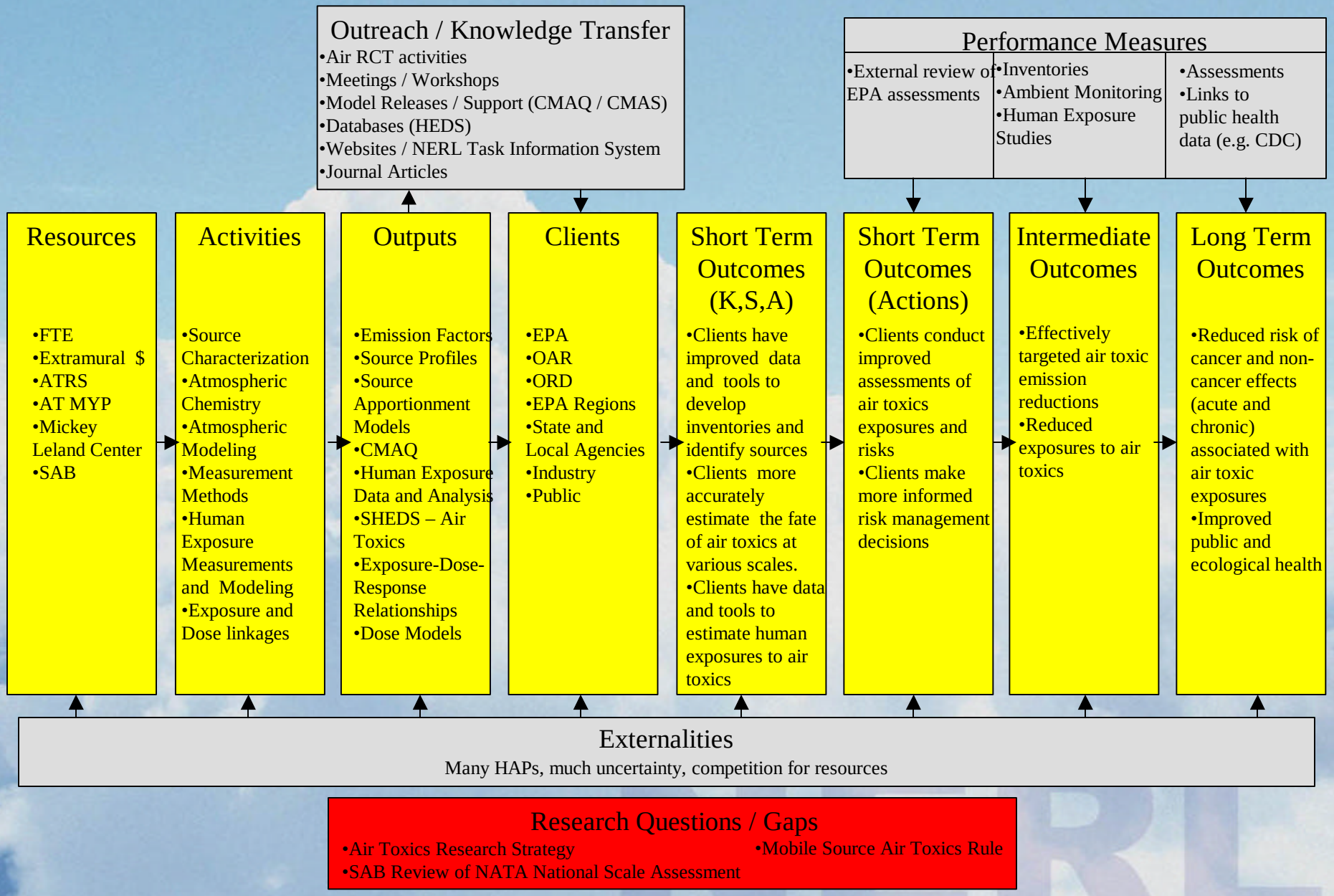
(Cote and Vandenberg, 1994)

- Incompatible exposure and health information impairs risk assessment
- Exposure assessment should consider the health risks of concern, e.g.
  - For chronic health conditions (e.g. cancer) monitor/model chronic exposures
  - For acute conditions monitor/model acute exposures (e.g. peaks)
  - For reproductive outcomes monitor/model exposures during critical periods of development

How ORD's Research Activities Improve Exposure Assessment



ORD Air Toxics Logic Diagram



Thoughts on this Workshop

- A Great Opportunity!!!
  - To provide information about ORD exposure assessment research
  - To make connections with Regional scientists
  - To better understand the exposure assessment needs of the Regions